By Melissa Black

Building a Better Highway

Road Work Doesn't Begin Until the Quality Testing Ends

Highways and bridges are only as good as the materials they're made of. That's why a team of Missouri Department of Transportation scientists, engineers and technicians work continually to find the breaking point for every nut, bolt and rock that goes into them so Missouri motorists can travel on the safest roads possible.

Shaker Room

Aggregate Laboratory

Freeze-Thaw Room

Oven Room

Since 1923, employees at the department's Central Laboratory have worked to ensure all the materials used in building and maintaining Missouri roads and bridges meet federal guidelines and the expectations of Missouri drivers.

The lab's history goes back to a report released in 1922 by the State Highway Board. According to the report, a central testing lab was needed because: "The only positive assurance of receiving a uniformly high grade of materials, and therefore the fullest return on each dollar expended, is the use of proper specifications and enforcement of such by inspection and tests."

This statement was true then, and the basic philosophy hasn't changed much in more than eight decades.

Today, the lab's work is divided into four areas: chemical laboratory, physical laboratory, a soils/geology section and field materials section.

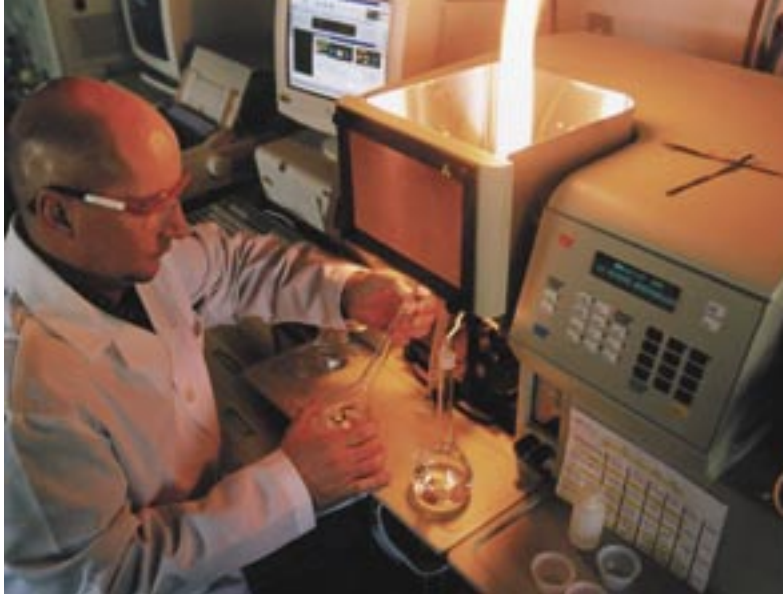
Chemical Laboratory

Anyone who ever took a chemistry class will have a good idea of what MoDOT's nationally accredited chemical laboratory looks like. There are chemists in white coats leaning over glass beakers, rows of vials set on spotless countertops and lots of complicated equipment that go by acronyms instead of names. It's a clean and orderly place.

The lab staff includes 12 chemists who test and analyze the chemical properties of thousands of samples of highway construction and maintenance materials like asphalt, cement, reflective sign sheeting, paint, signs, glass beads, rock salt, antifreeze and many other materials. This section approves or rejects the use of certain materials, handles materials specifications and evaluates new or improved materials.

They also test buildings MoDOT purchases for asbestos. In fact, they're one of only three state labs in the country certified to do asbestos testing. Two years ago the lab was internationally recognized by the National Institute of Standards and Technology when it received accreditation for bulk asbestos fiber analysis it performs.

Even materials like paint go through the lab's rigorous testing process. Wearing a



paint-spattered apron, jeans and a t-shirt, Analytical Chemist Jason Forrest doesn't fit the typical image of a chemist, but the tests he performs tell a different story.

Whether it's for traffic marking or bridge paint, Forrest tests everything from the weight of a brand of paint to its drying time. He performs anywhere from 10-15 different tests on as many as 20 different samples a day.

"Before I worked for MoDOT, I didn't even know they had chemists," Forrest says. "But, now that I work here, I understand how critical it is to maintain top-quality paint on our roads and bridges. People have to be able to see the marking on the roads in good and bad weather, day and night, and bridge paint has to last 20 years in today's environment."

He can be pretty hard on paint. When testing a new paint, Forrest performs accelerated weather testing to see how it will hold up over the coming years. Paint has to stand up to 3,000 hours under a corrosive salt solution and artificial sunlight for 4,000 hours. Overall, it takes about six months of testing to qualify a new paint for use on Missouri bridges.

"Chemistry is fun," Forrest says. "What I do as a chemist is day-to-day problem solving, but sometimes I get new and unique situations – that's the real fun stuff."

Physical Laboratory

Unlike the quiet and clean environment of the chemical laboratory, the physical laboratory is loud and smells strongly of petroleum products.

In one corner, thousands of bags of rocks fill a garage-sized room, waiting to be tested. Huge machines grind, crunch and pulverize concrete and asphalt samples. Another room contains numerous cans of asphalt cement, the black glue that mixes with small rocks to harden into asphalt.

This part of the lab is responsible for testing and evaluating the physical qualities of materials like asphalt mixtures, soils, high-strength bolts, concrete, steel, snowplow blades and even trash bags.

"Basically, if the department uses a material, we test it first," says Jeff Huffman, physical testing supervisor.

And while the chemical lab may bring up high school memories of the periodic table of elements, the physical lab is reminiscent of a home economics class. From the industrial-sized mixers to the huge ovens that bake the non-edible "cakes," the similarities are obvious.

Of course, the ingredients used to make these cakes are a lot tougher than flour and eggs. Mixing rock and asphalt concrete in the mixers proves hard on the beaters.

The physical tests performed here are critical to every person who travels a Missouri roadway. Will the bolts hold the weight of numerous vehicles over several years?

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Jeff Huffman, physical testing supervisor

Do certain rocks work better in asphalt or concrete? What type of concrete works best in each part of the state, and how will local soil affect it?

Speaking of soil, if you're under the perception that all dirt is basically brown, think again. Soil comes in a virtual rainbow of colors. From a large display on the wall, it's easy to see orange, red, yellow, brown, tan, black and other hues.

While some lab tests take as little as five minutes, others can take months. They perform thousands of various tests a year and retrieve hundreds of different samples. Because of these tests new roads last longer, rut less and have fewer potholes.

Soils and Geology

This 35-member staff stays busy inside and outside the lab collecting and testing soil and rock samples from around the state. The soils and geology section collects soil and rock samples for testing back in their lab. Staff members can then interpret the subsurface information needed to design highways and bridges. Personnel in this area are also on hand for emergency situations to investigate things like foundation stability and settlement of embankments, mines, failed walls and bridges and many others.

Tom Fennessey, senior materials engineer, gives the grand tour. Although an engineer by title, his fascination with geology is evident. His office, like many other areas in this lab, holds a varied collection of rocks.

"Our job in this section is to research and test the soils and rocks in different areas to determine how to make road and bridge design work best with nature," Fennessey says.

PHOTOS OPPOSITE PAGE: LEFT BY MIKE WRIGHT; RIGHT BY SHAUN SCHMITZ. PHOTOS THIS PAGE: TOP BY SHAUN SCHMITZ; BOTTOM BY DENNIS FORBIS

Twenty-one members of the soils and geology staff actually travel statewide as part of the department's core-drilling team. Using specialized equipment on barges and on land, coredrillers bore down into soil and rock to take critical samples needed for various reasons – whether to assess the stability of a future road or bridge foundation, or to check the subsurface conditions have changed under a current road or bridge. Since 1990, they have drilled samples for more than 1,000 structures.

"People may not realize it, but each bridge we build is different and customized to the environment in that area," Fennessey said. "Based on soil conditions, depth of bedrock in the area and strength of the rock, the information we bring back makes a big difference in how a bridge is designed."

Fennessey also says a big consideration in all new bridges is whether they will hold up during an earthquake.

"Certain subsurface conditions will allow a structure to withstand an earthquake better than others," he said. "Imagine shaking a plate of Jell-O – that's how an earthquake will feel to many of our bridges. Understanding these conditions and collecting the best data, allows us to design structures to better work with Mother Nature in cases like this."

Will a bridge approach settle during an earthquake? Why did a landslide occur? How steep can the slope of an embankment be? Will the foundation of a road or bridge remain solid? The group tackles these questions every day.

Field Materials

While members of the chemical and physical labs stay busy indoors, the field materials section is outside sharing the test results with other department staff.

"We really take the results from the other lab sections, write the appropriate material specifications and then ensure the districts understand the specifications," says Joe Schroer, field materials engineer. "We work with staff statewide to help ensure policies are followed and appropriate standards are set."

But they don't stop there. They also supervise the design of different asphalt and concrete mixtures and played the lead in implementing Superpave, a new technology developed by the Strategic Highway Research Program, a statewide effort to improve highway technology. Superpave consists of the same ingredients as other asphalt pavement, but a laboratory compaction process helps ensure an asphalt mixture will be durable.

Missouri was one of the first states to begin using this technology in 1996. "Superpave asphalt mix designs have become our standard for high traffic asphalt mixtures," Schroer said. "Observations of pavements with mixtures using the Superpave design process have early indications that these pavements will outlast mixtures using our previous design methods."

Technician Certification Program

A new area was recently added to the lab that will further increase the quality of MoDOT's building materials.

The Technician Certification Program trains and qualifies all inspectors statewide in all tests performed by the department and by contractors. This ensures quality testing, and statewide consistency, no matter who performs the tests.

Manuals, classroom training, hands-on experience and examinations equip district inspectors for any test out there. Currently, MoDOT has more than 1,600 active certified technicians in various areas.

Working Together Means Better Roads in the Future

The word "quality" is heard frequently around the lab. State Construction and Materials Engineer Connie Baldwin says the lab provides the crucial quality-assurance element MoDOT needs, but does it at a cost-savings.

"To perform just the routine testing that we do would cost two to three times more somewhere else," Baldwin said. "Besides the fact that independent labs have limited availability, and most are located long distances from Missouri. Our lab staff provides the needed material testing and evaluation quickly and more inexpensively than we could get it elsewhere. This lab and its staff are something we can all be proud of."

Whether gathering and testing samples or training inspectors, all of MoDOT's Central Laboratory employees are focused on only one goal – quality. Physical Laboratory Director Will Stalcup sums it up.

"All of the lab sections work together to make sure MoDOT is using the best quality materials in construction and maintenance," Stalcup says. "We care about the final product, and we are constantly testing and evaluating highway materials to ensure motorists have the best driving lanes to travel on." ■

Melissa Black is Operations outreach coordinator at MoDOT General Headquarters.

PHOTOS OPPOSITE PAGE: TOP LEFT BY MIKE WRIGHT; TOP RIGHT BY DENNIS FORBIS; BOTTOM BY CATHY MORRISON
PHOTOS THIS PAGE BY MIKE WRIGHT

No Bridge Too Far

By Bob Brendel

While MoDOT scientists, engineers and technicians are performing laboratory tests, inspectors in the Bridge division take their show on the road to guarantee the steel elements used in Missouri's thousands of bridges are of the highest quality.

Steel does not come from the mill in its finished, ready-to-use form. It is shipped to fabrication shops around the country where the steel is cut, bent, pressed and welded into useable forms. In the case of MoDOT, that's the creation of girders and plates that are used in bridge construction.

After a construction contract is awarded, the contractor subcontracts the girders to a steel fabricator, who in turn draws up a series of working or "shop drawings" that are reviewed by MoDOT's bridge experts for general conformity to the project plans.

Once production of those steel elements begins, a fabrication technician from MoDOT General Headquarters in Jefferson City travels to the shop to observe the production process, and also to serve as a resource for the fabricator in the event of questions or problems.

For example, steel for the new Missouri River bridge in Lexington, Mo., is being fabricated in Oklahoma City. Some other shops are located in Kentucky, Texas, Arkansas and right in MoDOT's Jefferson City home.

"The technician performs spot checks for general conformity to our plans and specs," says Paul Kelly, senior technical support engineer who directs MoDOT's plans production and fabrication sections. It's important because of the wide array of processes that are performed. Steel is cut to length and width, cleaned, welded together, and even painted. "Welding, especially, is extremely important," Kelly said.

The MoDOT inspector, though, is not there to stop the assembly line.

"Each shop has its own QC (quality control) process," Kelly explains. "Our inspectors, obviously, work closely with that staff. (But) we're not there to replace them. We're really in more of a quality-assurance role. The ultimate responsibility is theirs."

Traveling to the fabrication site is most efficient. It would be extremely costly and cause significant project delays if steel were shipped to the job site, rejected, and returned to the fabricator.

MoDOT has worked over the past decade to build up a stable of competitive fabricators.

"We've also held an annual meeting for the last 10-12 years that is a good one-day exchange of information," Kelly said. "We can ask them, 'Are our plans clear? Are our specs clear?' And at the same time we can let them know if we see things in the steel industry that could be improved."

Kelly explains that competition enables MoDOT to balance the situation where it wants to find the lowest price while realizing that the supplier also desires to make a profit. "Of course, though, the most important factor is that the girder be of good quality. We can't have a bad weld or the kinds of things that can cause a catastrophe."

The inspection services provided by MoDOT in fabrication shops around the nation ensure that Missouri's bridges are safe for the motoring public.

Bob Brendel is Project Development outreach coordinator at MoDOT General Headquarters.